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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/716,750	11/19/2003	Li-Peng Wang	884.600US2	6210
21186	7590	06/07/2004	EXAMINER	
SCHWEGMAN, LUNDBERG, WOESSNER & KLUTH, P.A. P.O. BOX 2938 MINNEAPOLIS, MN 55402			DOUGHERTY, THOMAS M	
			ART UNIT	PAPER NUMBER
			2834	

DATE MAILED: 06/07/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Applicati n N .

10/716,750

Applicant(s)

WANG ET AL.

Examiner

Thomas M. Dougherty

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 13 May 2004.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 29-44,50 and 51 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 29-42,44,50 and 51 is/are rejected.
- 7) ☒ Claim(s) 43 is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 19 November 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |   |   |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)   | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)  | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date <u>1103</u> . | 6) <input type="checkbox"/> Other: _____  |

## DETAILED ACTION

### ***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 29, 32-36, 39-42, 44, 50 and 51 are rejected under 35 U.S.C. 103(a) as being unpatentable over the applicants' prior art figures (1 and 2) in view of Beam, III et al. (US 5,935,641). The applicants' prior art figure (1) shows a film bulk acoustic resonator device (100) formed on a substrate (110) having an opening (150) therein, the film bulk acoustic resonator (100) comprising: a layer of piezoelectric material (130) spanning the opening (150).

The prior art device includes a conductive layer.

The device further comprises a first conductive layer (120) and a second conductive layer (122), the first conductive layer (120) deposited on a first surface of the piezoelectric material (130), and the second conductive layer (122) deposited on a second surface of the layer of piezoelectric material (130).

The device further comprising: a first electrode (120); and a second electrode (122), wherein the first conductive layer (120) is a portion of the first electrode and the second conductive layer (122) is a portion of the second electrode.

The device's piezoelectric material is a single-crystal film.

The device's piezoelectric material is AlN.

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The device's piezoelectric material is ZnO.

The layer of piezoelectric material is a C-axis orientated film.

Regarding the recitation of these materials the Applicants' include virtually all possible piezoelectric materials in their description of the prior art figure. See p. 2, ll. 18+ of the disclosure.

The film bulk acoustic resonator further comprising a source of RF voltage (210) attached between the first conductive layer (120) and the second conductive layer (122).

The film bulk acoustic resonator further comprising a source of RF voltage (210) attached between the first electrode (120) and the second electrode (122).

It is not clear whether or not the applicants' prior art figure (1A) includes a seed layer exposed about the periphery of the opening (150). There is a layer on the substrate below the piezoelectric layer but this layer is not identified.

Beam III, et al. teach (fig. 1C) a resonator device (10) formed on a substrate (12) the resonator (10) comprising: a seed layer (16) on the substrate and a layer of piezoelectric material (20) on top of the seed layer.

The seed layer (16) is in a first plane and the layer of piezoelectric material (20) is in a second plane.

The seed layer (16) is non-conductive (see col. 3, l. 2).

Beam III, et al. do not show an opening in their substrate.

It would have been obvious to one having ordinary skill in the art to employ the seed layer about the periphery in the device of the prior art invention at the time that

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invention was made in order to provide for a bulk piezoelectric layer having improved texture as noted by Beam III, et al. in their ABSTRACT.

Claims 29-36, 39-42 and 44 are rejected under 35 U.S.C. 103(a) as being unpatentable over Larson, III et al. (US 6,566,979) in view of Beam, III et al. (US 5,935,641). Larson, III et al. show a film bulk acoustic resonator (see TITLE) device (40) formed on a substrate (42) having an opening therein (e.g. 51), the film bulk acoustic resonator (10) comprising: a layer of piezoelectric material (54) spanning the opening (51).

The opening (51) has a larger area near the layer of the piezoelectric material (54) and a smaller area remote from the piezoelectric material (54).

The substrate (42) further includes a major surface, the opening further including at least one sidewall, the angle between the at least one sidewall and the major surface of the substrate [is] at an angle other than perpendicular.

Larson's, III et al. device includes a conductive layer (e.g. 52).

The device further comprises a first conductive layer (52) and a second conductive layer (57), the first conductive layer (52) deposited on a first surface of the piezoelectric material (57), and the second conductive layer (57) deposited on a second surface of the layer of piezoelectric material (54).

The device further comprising: a first electrode (52); and a second electrode (57), wherein the first conductive layer (52) is a portion of the first electrode and the second conductive layer (57) is a portion of the second electrode

The device's piezoelectric material can be a single-crystal film.

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The device's piezoelectric material is AlN.

The device's piezoelectric material can be ZnO.

The layer of piezoelectric material can be a C-axis orientated film.

Regarding the recitation of these materials note that Larson, III et al. discuss that the piezoelectric material may be "any suitable material" at col. 6, ll. 31-33, which description includes the claimed materials.

Larson's, III et al. do not show a seed layer exposed about the periphery of the opening.

Beam III, et al. teach (fig. 1C) a resonator device (10) formed on a substrate (12) the resonator (10) comprising: a seed layer (16) on the substrate and a layer of piezoelectric material (20) on top of the seed layer.

The seed layer (16) is in a first plane and the layer of piezoelectric material (20) is in a second plane.

The seed layer (16) is non-conductive (see col. 3, l. 2).

Beam III, et al. do not show an opening in their substrate.

It would have been obvious to one having ordinary skill in the art to employ the seed layer about the periphery in the device of the Larson, III et al. at the time that invention was made in order to provide for a bulk piezoelectric layer having improved texture as noted by Beam III, et al. in their ABSTRACT.

Claims 37-38 are rejected under 35 U.S.C. 103(a) as being unpatentable over the combined invention of Larson, III et al. (US 6,566,979) and Beam III, et al. (US 5,935,641) further in view of Ylilami et al. (US 2003/0102773 A1). Given the combined

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invention of Larson, III et al. and Beam III, et al. as noted above, they fail to show at least one of the first electrode, and the second electrode with portions which are in different planes, or both the first and second electrode have portions which are in different planes.

Ylilammi et al. show a film bulk acoustic wave (see title) device (fig. 1A) formed on a substrate (42), the film bulk acoustic resonator comprising: a layer of piezoelectric (52) material over the substrate (42).

They further show a first conductive layer (AU on layer 48); and a second conductive layer (54), the first conductive layer deposited on a first surface of the piezoelectric material (52), and the second conductive layer (54) formed a second surface of the layer of piezoelectric material (52).

They further show a first electrode (AU layer on top of layer 48); and a second electrode (54), wherein the first conductive layer is a portion of the first electrode, and the second conductive layer (54) is a portion of the second electrode (54).

At least one of the first and second electrode (54) has portions which are in different planes.

Both the first electrode, and the second electrode (54) have portions which are in different planes.

It would have been obvious to one having ordinary skill in the art to employ the combined device invention of Larson, III et al. and Beam, III et al. in the device of Ylilammi et al. at the time the Ylilammi et al. invention was made in order to take

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advantage or the provision of a bulk piezoelectric layer having an improved texture as is noted above.

Claims 29-38 and 44, are rejected under 35 U.S.C. 103(a) as being unpatentable over Wadaka et al. (EP 0 771 070 A2) in view of Beam, III et al. (US 5,935,641).

Wadaka et al. show (fig. 56) a film bulk acoustic resonator device formed on a substrate (1) having an opening (7) therein, the film bulk acoustic resonator comprising: a layer of piezoelectric material (2) spanning the opening (7).

The opening (7) has a larger area near the layer of the piezoelectric material (2) and a smaller area remote from the piezoelectric material (2).

The substrate (1) further includes a major surface, the opening (7) further including at least one sidewall, the angle between the at least one sidewall and the major surface of the substrate (1) [is] at an angle other than perpendicular.

The Wadaka et al. prior art device includes a conductive layer (e.g. 5).

The device further comprises a first conductive layer (5) and a second conductive layer (6), the first conductive layer (5) deposited on a first surface of the piezoelectric material (2), and the second conductive layer (6) deposited on a second surface of the layer of piezoelectric material (2).

The device further comprising: a first electrode (5); and a second electrode (6), wherein the first conductive layer (5) is a portion of the first electrode and the second conductive layer (6) is a portion of the second electrode (6).

At least one of the first electrode (5), and the second electrode (6) has portions which are in different planes.



Both the first electrode (5) and the second electrode (6) have portions which are in different planes.

It is not clear whether or not Wadaka's et al. device includes a seed layer. There is a layer on the substrate below the piezoelectric layer but this layer is not identified explicitly as a seed layer..

Beam III, et al. teach (fig. 1C) a resonator device (10) formed on a substrate (12) the resonator (10) comprising: a seed layer (16) on the substrate and a layer of piezoelectric material (20) on top of the seed layer.

The seed layer (16) is in a first plane and the layer of piezoelectric material (20) is in a second plane.

The seed layer (16) is non-conductive (see col. 3, l. 2).

Beam III, et al. do not show an opening in their substrate.

It would have been obvious to one having ordinary skill in the art to employ the seed layer about the periphery in the device of the Wadaka et al. at the time that invention was made in order to provide for a bulk piezoelectric layer having improved texture as noted by Beam III, et al. in their ABSTRACT.

#### ***Allowable Subject Matter***

Claim 43 is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

The following is a statement of reasons for the indication of allowable subject matter: the prior art fails to show or fairly suggest use of a piezoelectric material

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including both a C-axis oriented portion and a non C-axis portion wherein at least a portion of a first conductive layer and a portion of a second conductive layer is proximate the C-axis portion of the layer of the piezoelectric material in a Film Bulk Acoustic Resonator structure.

### **Conclusion**

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. The prior art cited all reads on at least some aspects of the claimed invention. Masami (JP 2000-263784) notes use of a piezoelectric film resonator with a cavity in the substrate and further employing a seed layer; Peczalski (US 2003/0057806 A1 and WO 03/028211) notes use of a seed layer in his film bulk acoustic resonator device; Bradley notes (US 2004/0021191 A1 and 2004/0021400 A1) most of the features of the claimed invention but his seed layer covers the cavity and his dates preclude application of the reference to the present application. Krishnaswamy et al. (US 5,233,259) note use of C-axis oriented piezoelectric film in his film bulk acoustic resonator device. Ohara et al. (US 2003/0067368 A1) show a stepped electrode (1) in their cover figure.

Direct inquiry concerning this action to Examiner Dougherty at (571) 272-2022.

*tmd*  
tmd

May 28, 2004

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